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Lighting Systems

Subject **Page**

Initial Print Date: 12/04 Revision Date:

Lighting Systems

Model: E38, E39 and E53

Production: Start of Production MY 2004

OBJECTIVES

After completion of this module you will be able to:

- Understand the operation of LCM.
- Locate and Identify components of the lighting system.
- Dlagnose lighting system concerns.
- Understand Xenon lighting systems.

Light Check Module (LCM)

Upon the initial introduction of the E38 in 1995, the lighting system was controlled by the Lamp Module (LM). The LM worked in conjunction with the Check Control Module (CCM) to control and monitor exterior lights.

From 9/95 production, the LM and CCM were combined to form the Light Check Module (LCM). The new LCM provides a cost savings by combining the two functions into one processor.

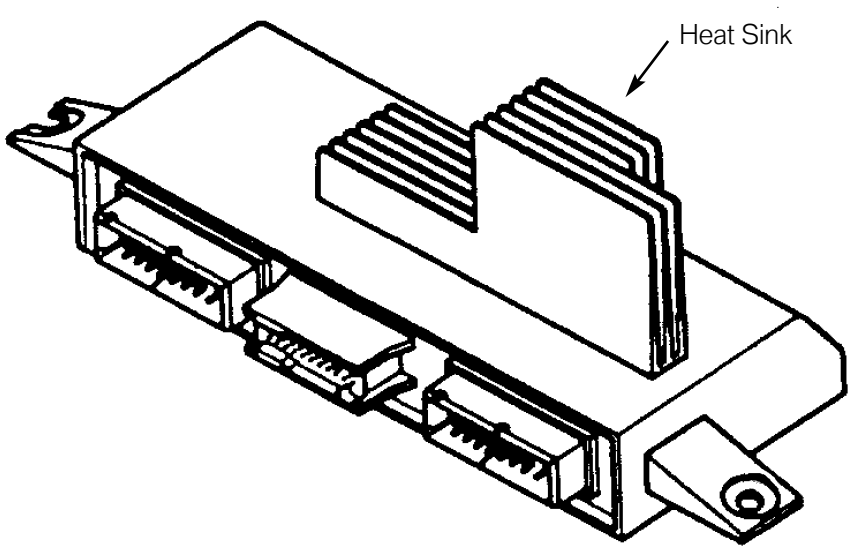
It is installed in the right kick panel where the LM of the 95 E38 was installed. Both versions of instrument clusters use the LCM for processing Check Control data and controlling the exterior lighting functions of the vehicle. The LCM communicates with other modules over the "I" and "K" busses.

Functions of the LCM include:

- Monitoring of all check control inputs
- Formation and output of check control messages or signals
- Control of all vehicle external lighting
- Monitoring of all external lighting for operation
- Instrument panel illumination dimming (KL 58g) signal
- Control of instrument cluster indicator lights - for high beam, turn signal and fog light indicators.

For proper operation of the check control and lamp control functions, the LCM must be coded with the Central Coding Key (ZCS) if replacement is required.

LCM



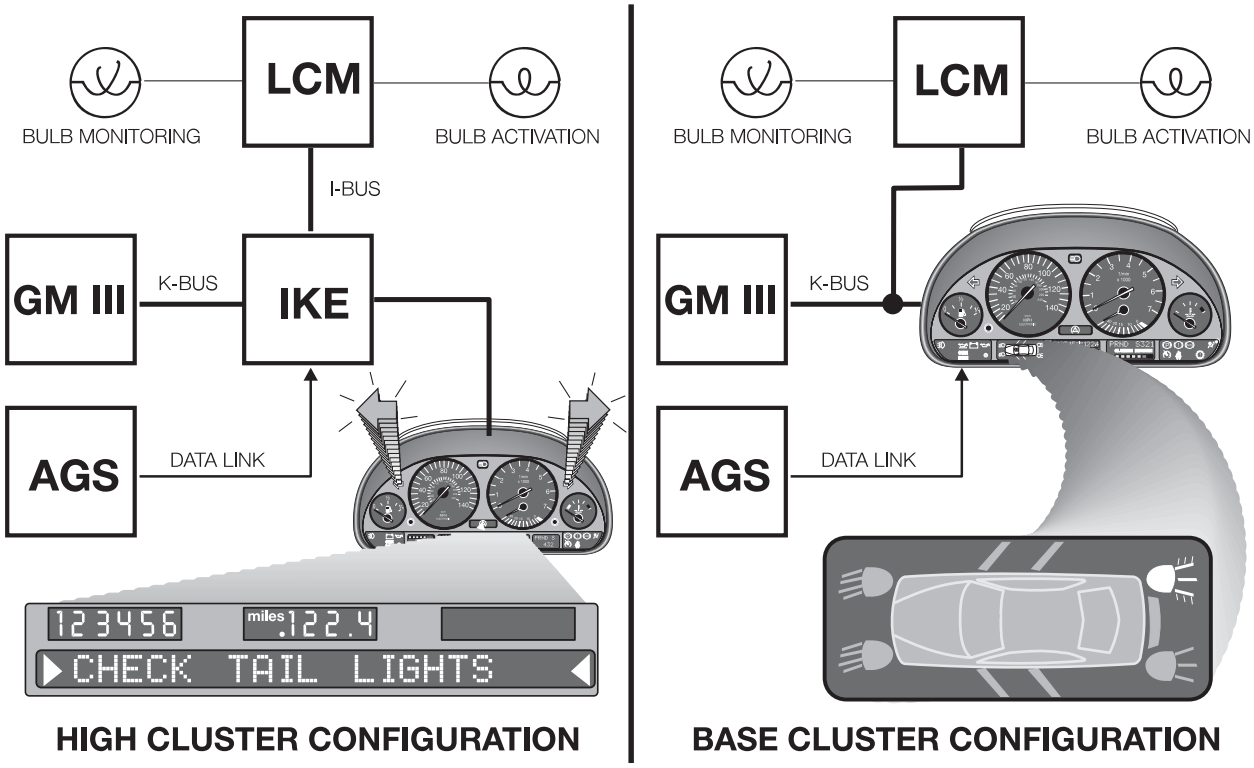
The LM/LCM reduces a number of components that were used in the past.
The LM/LCM replaces:

- Numerous relays
- Flasher unit
- Crash control unit (relay)
- Cold check relay
- Dimmer

The LCM transmits and receives status information concerning light operation. It also communicates to the IKE when turn signal, high beam, and fog light indicators need to be activated.

The LCM is informed by ZKE when a crash has occurred or the alarm was tripped for headlight / flasher activation.

When reverse is selected, the LCM is signaled to turn on the back-up lights. All of this communication takes place over the Bus system.



Lamp Control and Monitoring

Lamp control and monitoring on the E39 and E53 follow the E38 in design and function. All exterior lighting is controlled by the LCM. It contains transistor power output stages for activating the lights. This eliminates the need for fuses and relays previously used for this purpose.

The LCM receives the input request for light illumination from the various switches and data inputs from other control modules. The LCM then switches the power output stages ON for lamp activation.

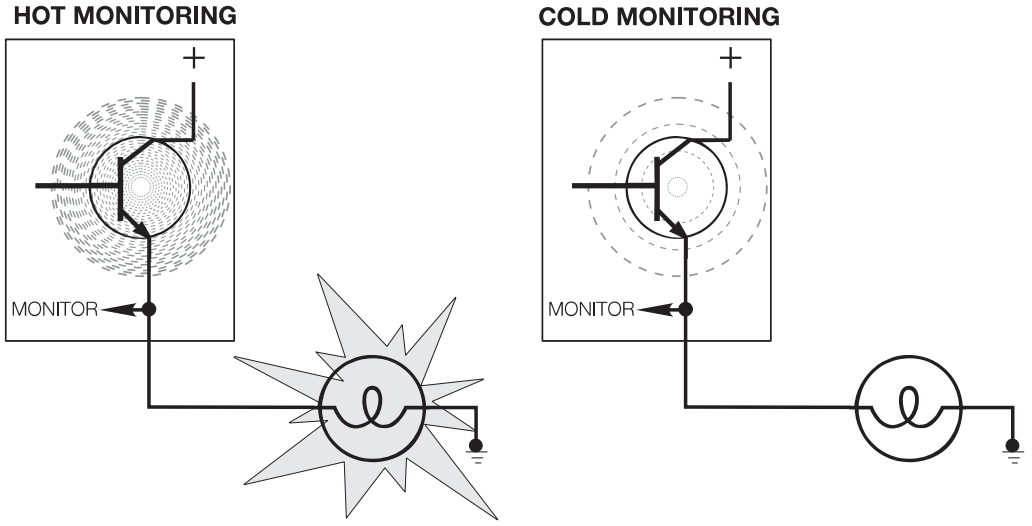
Other control modules that communicate with the LCM include:

- IKE over the I/K bus for turn signal, high beam and fog lamp indicator illumination.
- The ZKE for crash alarm indication.
- The AGS (EGS) control module for back up lamp activation.

All exterior lighting is monitored (both hot and cold) by the LCM. When the monitored value exceeds an acceptable level (high or low) the LCM generates and sends the signal to the IKE or base instrument cluster for check control display. This monitoring takes place in timed cycles.

- Hot monitoring takes place from the LCM by monitoring the current flow through the output stages. The current flow is determined by looking at the voltage drop of the circuit.
- Cold monitoring takes place by the LCM by briefly switching the lights ON using a small amount of current. The LCM uses this to measure the voltage drop of the circuit. The small amount of current is not enough to cause the lights to illuminate.

Note: Due to the hot and cold monitoring of the lamp circuits, it is important that the lamps used are of the correct wattage. Incorrect or substandard bulbs can affect voltage drop and therefore possibly set erroneous check control messages.



Bulb Ratings

The chart below shows the wattage rating of some of the exterior lamps. In order for the bulb monitoring circuits to function correctly, the proper wattage ratings must be considered. The chart should only be used for reference. The proper rating can be found in technical data Group 63.

The Low beam Xenon headlight systems are not cold monitored, however current can be measured when switched on to allow for Hot monitoring to be functional.

Bulb	Wattage Rating	Hot monitored	Cold monitored
Low Beam (non Xenon	65	X	X
High Beam	55	X	X
Foglight	55	X	X
Front side marker	5	X	X
Blinkers	21	X	
Blinker indicators	5		
Tail lights	5	X	X
License plate lights	10	X	X
Brake lights	21	X	X
Backup lights	21	X	X

LCM Input Signals

Input signals to the lighting module are from the following switches:

- Park / low-beam light switch
- High-beam/headlight flash switch
- Turn signal switch
- Fog light switch
- Hazard switch
- Brake light switch
- Dimmer control

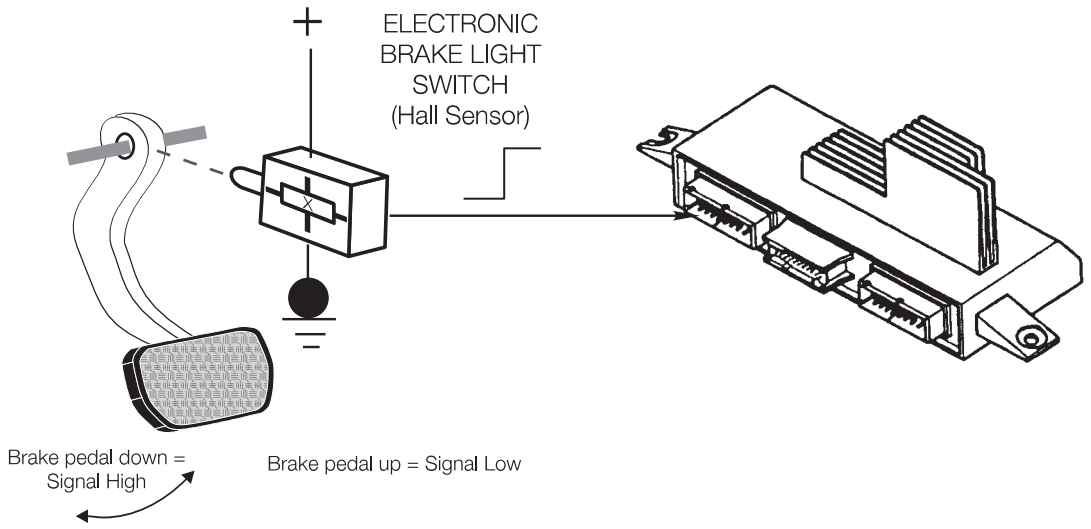
These inputs are ground switched except for the brake light switch.

Brake Light Switch

Brake light switch is now a hall-effect transmitter with three connections. The first connection is power, supplied from KL R, with the second being ground. The third connection is the signal wire to the LCM.

The electronic brake light switch eliminates the need for the brake test switch. If the brake switch or it's circuits fail, the brake lights will be permanently on from KL R.

The signal wire from the electronic brake light switch is active when the brakes are applied sending a 12 volt signal to the LCM. When the brake light switch is in the rest position, there is a small digital signal of approximately 100mv present on the signal line. If this signal is interrupted, the LCM will switch the brakes lights on as a safety measure.



Dimmer

The LCM controls the KL 58g circuit (instrument cluster, LCD, and switch back lighting). The KL58g signal is a pulse width modulated signal which is an output of the LCM as well as a signal output over the bus line.

The dimmer input to the LCM on early models is via a potentiometer. Later models use an electronic dimmer which uses a pulse-width modulated signal to the LCM.

Light Switch Illumination

A separate circuit is used to back light the symbol of the light switch. The symbols are fully illuminated when KL R is switched on and the lights are off. After the lights have been turned on, the switch back lighting is reduced to the same intensity as KL 58g.

Emergency Operation

If there is a failure of the LCM processor, an emergency circuit is activated within the LCM. This will allow the following lights to function for driving safety:

- Side marker/tail lights
- Low-beam lights
- Brake lights
- Turn signals

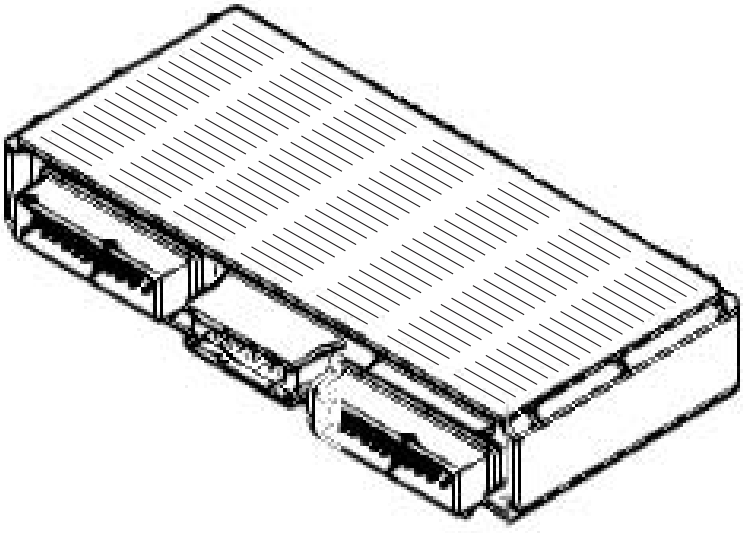
In emergency operation the following lights will not operate:

- Dimming control (full bright)
- Hazard lights
- High-beam lights
- Headlight flash
- Fog lights
- Back-up lights

The I-Bus/K-Bus communication to the LM will also be interrupted.

LCM III

From 9/98 production, the new LCM III was introduced with increased feature and functions. The module itself has been redesigned with new semi-conductor final stages that produce less heat in operation. This allows for the elimination of the protruding heat sink found on the previous LCM.



The total scope of function and features has been expanded to improve comfort and safety for the driver and passengers. Features and functional changes include:

- Replacement lighting for the parking lights
- Limiting of output voltage to the lamps
- Follow Me Home lighting (delayed exit)

Replacement Lighting

The LCM can use substitute bulbs for various lights if a failure should occur, for example:

- **Front parking lights** - If one of the parking lamps should fail, the LCM will illuminate the turn signal bulb on the affected side. The lamp will be dimmed by the LCM so that the intensity is the same as the parking lamp.
- **Rear tail lights** - If one of the rear tail lights should fail, the LCM will switch on the brake lamp on the affected side. The lamp will be dimmed to the intensity of the tail lamp.

Output Voltage Limiting Function

The output voltage applied to the parking and tail lamps is regulated to increase the life of the lamps. If the voltage at the LCM increases over 12.5 volts, the LCM will reduce the voltage to 12 volts.

Follow Me Home Lighting

This is a convenience feature which provides lighting for the driver and passengers to leave their vehicle and enter their home.

This feature is switched on by pulling the headlight flasher switch after the headlights and ignition have been switched off. This feature is switched off after a coded time delay or by switching the ignition on.

Xenon Headlight Systems

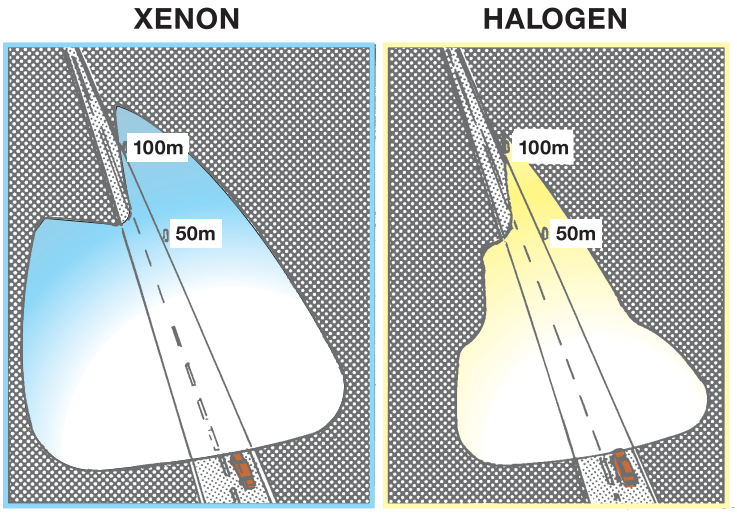
In order to improve night time driving visibility, Xenon headlight systems were developed for the automotive industry. Xenon technology is also referred to as High Intensity Discharge lighting or HID.

For BMW vehicle Xenon technology was first introduced to the US market in 1993 on the E32 750iL. Since this time Xenon technology has evolved and spread throughout the model lineup.

The first thing noticed about Xenon lamps is the blue/white appearance of the headlights.

There are numerous benefits to Xenon headlights and these include:

- Longer bulb life - typically the xenon bulbs will last from 3 to 5 times longer than conventional halogen bulbs.
- Increased light output - Xenon headlights produce 2.5 to 3 times more light (lumens) than halogen headlights.
- Blue/white light - The blue/white light emitted from Xenon headlights simulates a natural daylight appearance as opposed to the yellowish light from halogen bulbs. The light color of a light source is measured in color temperature (do not confuse with thermal temperature). Color temperature is measured in Kelvins (K). The higher the number, the whiter the light appears to be.
  - Natural daylight = 4,500 to 5000 K
  - Xenon headlights = 4,000 to 4,500 K
  - Halogen headlights = 3,200 K (yellow)
- Better driving visibility - the combination of higher lumens and color temperature provides a superior lighting source. The beam is wider and brighter in front of the vehicle than conventional halogen bulbs improving safety and driver comfort.



LWR

On vehicles equipped with Xenon headlights systems, it is necessary to prevent the light beam from affecting oncoming traffic. The Headlight Beam Throw Control (LWR) system is used to adjust the headlights horizontally (on a vertical plane). The is accomplished by using stepper motors in the headlight assembly.

The stepper motors are controlled by the LWR control module based on inputs from front and rear mounted ride level sensors.

As the vehicle suspension is loaded by driving or by passengers and cargo, the LWR module corrects the headlight position. This ensures the optimum headlight adjustment.

Version Identification

Xenon systems on BMW vehicles are supplied by two manufacturers - Bosch and Hella. These systems vary between models.

The first version system on the E38 is referred to as Generation 2.1 an can be identified by the flat bottom edge on the headlight housing.

The Generation 3 system has been introduced on the 1999 model year E38 and can be identified by the rounded (scalloped) edge of the headlight assembly.

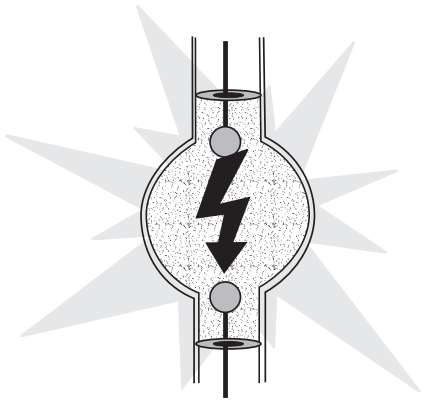
Headlight Replacement Parts

In previous model years, individual replacement parts were not available for headlight assemblies. This was due to the Federal Motor Vehicle Safety Standards (FMVSS) relating to the pitting or corrosion of the reflector components in non-sealed beam headlight assemblies.

BMW has submitted corrosion test data for headlight components which have passed the FMVSS providing the availability of headlight assembly spare parts. This approval has been given for all Bosch headlight assemblies (including halogen).

Vehicle Model	Model Year	Manufacturer/Version	LWR (Yes/No)	Individual replacement parts availability
E32 (750iL)	93-94	Hella (Light & Control module) Generation 1	No	No
E38 (750iL)	95-98	Bosch (Light & Control module) Generation 2.1	No	Yes
E38 (All)	99-01	Bosch (light) and Hella (control module) Generation 3	Yes	Yes
E39 (All)	99-02	Hella Generation 3	Yes	No
E46	99-	Bosch Light and Control Module	Yes	Yes

Xenon High Intensity Discharge Bulbs



Xenon bulbs are identified as D2-S. Xenon bulbs illuminate when an arc of electrical current is established between two electrodes in the bulb. The xenon gas sealed in the bulb reacts to the electrical excitation and head generated by the current flow. The distinct blue/white light is the result of the xenon gas reacting to the controlled current flow.

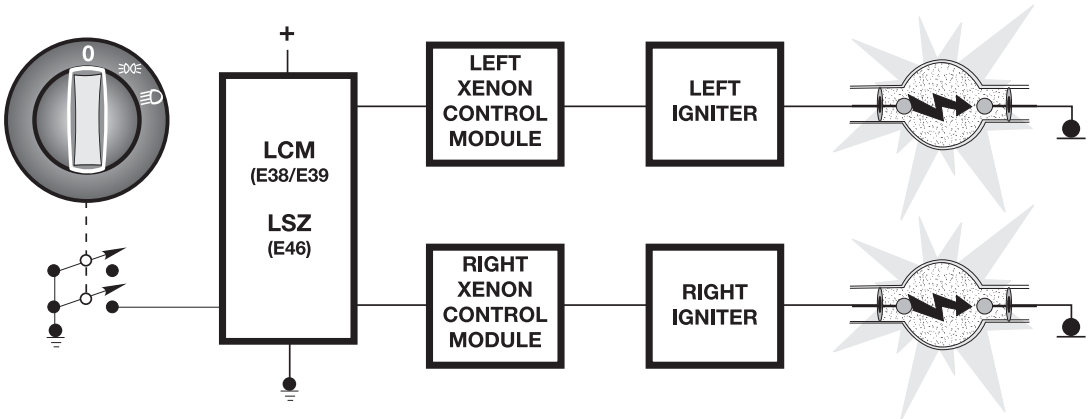
Phases of Bulb Operation

- Starting phase - the bulb requires an initial high voltage pulse of 18-25kV to establish the arc.
- Warm up phase - Once the arc is established, the power supply to the bulb is regulated to 2.6 amps generating a lamp output of 75 watts. This is the period of operation where the xenon gas begins to brightly illuminate. The warm up phase stabilizes the environment in the bulb ensuring continual current flow across the two electrodes.
- Continual phase - once the warm up phase is completed, the system switches to a continuous mode of operation. The supply voltage for the bulb is reduced and the operation power required for continual bulb illumination is reduced to 35 watts which is less than a conventional halogen bulb.

Functional Description

To regulate the power supply to the bulbs, additional components are required. The xenon control modules (1 per light) receive operating power from the LCM when the headlights are switched on.

The xenon control modules provide the regulated power supply to illuminate the bulbs through their phases of operation. The igniters establish the electric arcs. Integral coils generate the initial high voltage starting pulses from the control module provided starting voltage. Thereafter they provide a closed circuit for the regulated power output from the

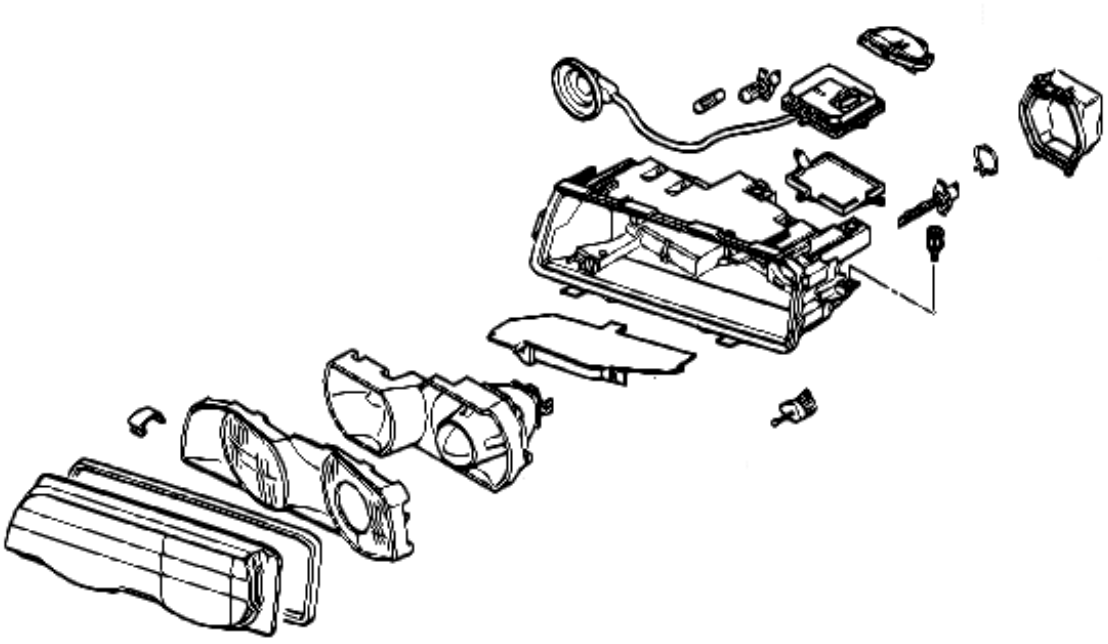


Xenon Bulb Monitoring

Xenon bulb function is monitored by the LCM. The bulbs are only “hot” monitored. Cold monitoring is not possible since the lighting control module is not in direct control of the xenon bulb. For this reason cold monitoring for low beam headlights is encoded off in the lighting control module for Xenon headlight equipped vehicle.

The lighting control module detects xenon bulb failure via a reduction in current flow to the xenon control module. When a bulb fails, the xenon control module’s current consumption drops to 60mA indicating unsuccessful xenon bulb illumination. The lighting control module then posts the appropriate matrix display message or LED illumination in the Check Control Pictogram display.

Xenon Headlight Assembly Components



Headlight Beam Throw Control (LWR)

Overview

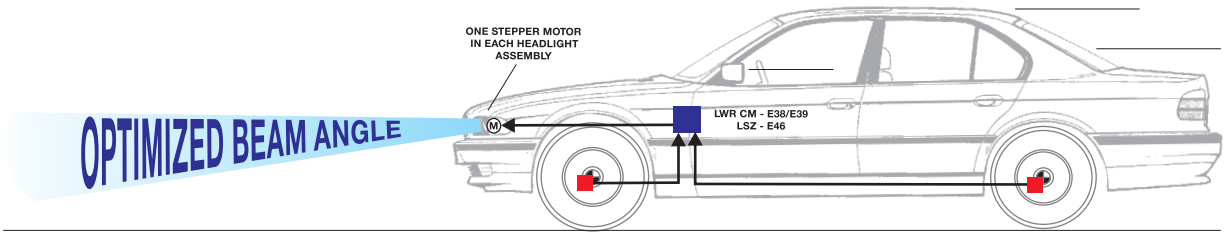
LWR automatically adjusts the vertical positioning of the headlights to maintain optimum headlight beam positioning for maximum driving visibility and to prevent undue glare for oncoming motorists. The system compensates for vehicle load angle changes (ie: diminishing reserve of gasoline in fuel tank during a long journey, overloaded cargo weight, etc.)

LWR has been available on BMW vehicles in other markets for quite some time. Starting with the 1999 model year all US market vehicles with Xenon Lights incorporate LWR as standard equipment. LWR is not available with standard halogen headlights.

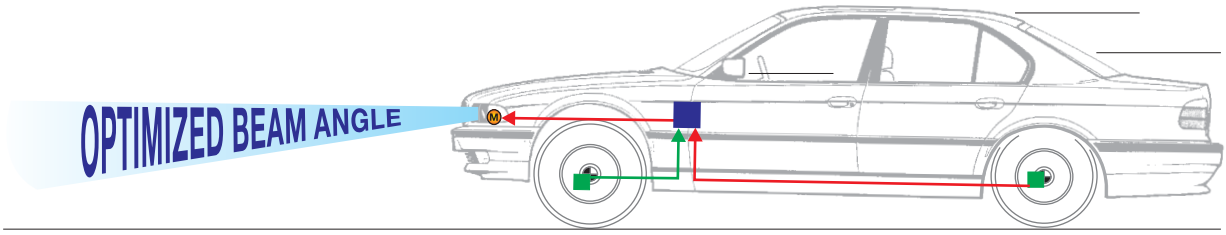
LWR monitors the vehicle's loaded angle via two hall effect sensors mounted to the front and rear suspension members. When an adjustment is necessary, LWR simultaneously activates two stepper motors (one in each headlight assembly).

The stepper motors drive a threaded rod that moves the lower edge of the headlight carrier plate forward and backward (depending on driven direction). The upper edge of the headlight carrier plate is fixed on a pivot. The pivoting movement adjusts the vertical position of the headlight beam.

NORMALLY LOADED VEHICLE



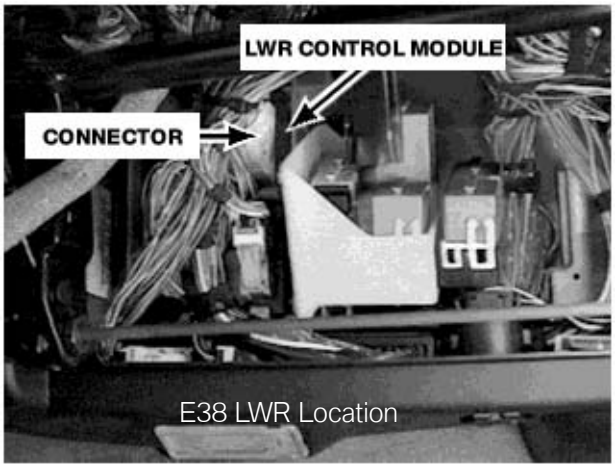
OVERLOADED VEHICLE (EXAGGERATED)

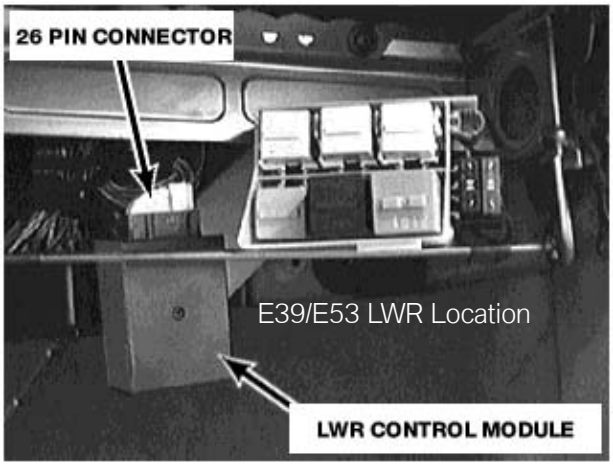


LWR Components

LWR Control Module - E38, E39 and E53 Vehicles

The LWR control module is located in the electronics carrier forward of the glovebox. The control module connects to a single, 26 pin, yellow harness connector. The control module has diagnostic capabilities and communicates with the DISplus/GT-1 via the K-Bus - IKE gateway to the D-Bus.

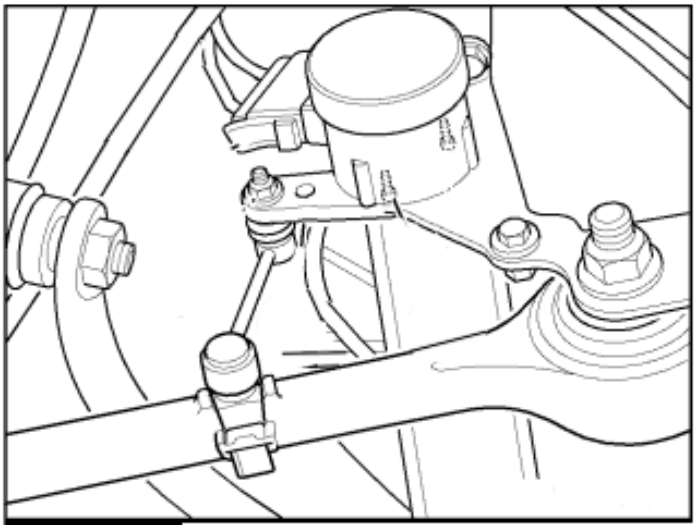




Level Sensors

LWR monitors two hall effect level sensors to determine vehicle load angle. The sensors are mounted to a fixed point on the suspension carriers of the front and rear axles.

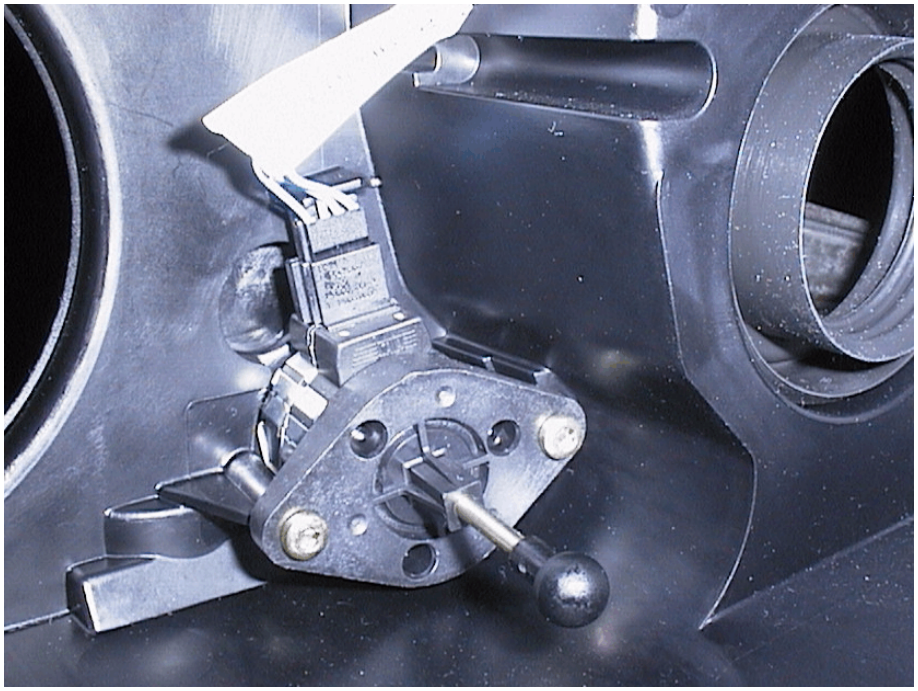
A lever is connected to the moving suspension member which changes the sensors output linear voltage signal as the suspension moves up and down.



Note: E39 sport wagon vehicles with EHC have a dual output sensor at the right rear location. This sensor shares the same housing as the EHC systems right rear level sensor.

Headlight Adjustment Stepper Motors

One stepper motor is located inside each headlight assembly. The 4 wire stepper motors are controlled by the LWR control electronics to change the vertical headlight position.



Functional Description

The E38/E39 LWR system comes on-line when the lights are switched on. The LWR control electronics then cycles the stepper motors through their full range of motion and stops at a default position.

The control electronics monitors the level sensor input signals to determine the vehicles load angle and adjusts the beam position accordingly. As the vehicle is driven it continually monitors the level sensor signals and if necessary updates the headlight beam positions every 25 seconds on the E46 or momentarily on the E38/E39 system.

Abrupt fluctuations of the sensor signals are filtered to prevent unnecessary adjustment as well as monitoring road speed and brake pedal application as correction factors.

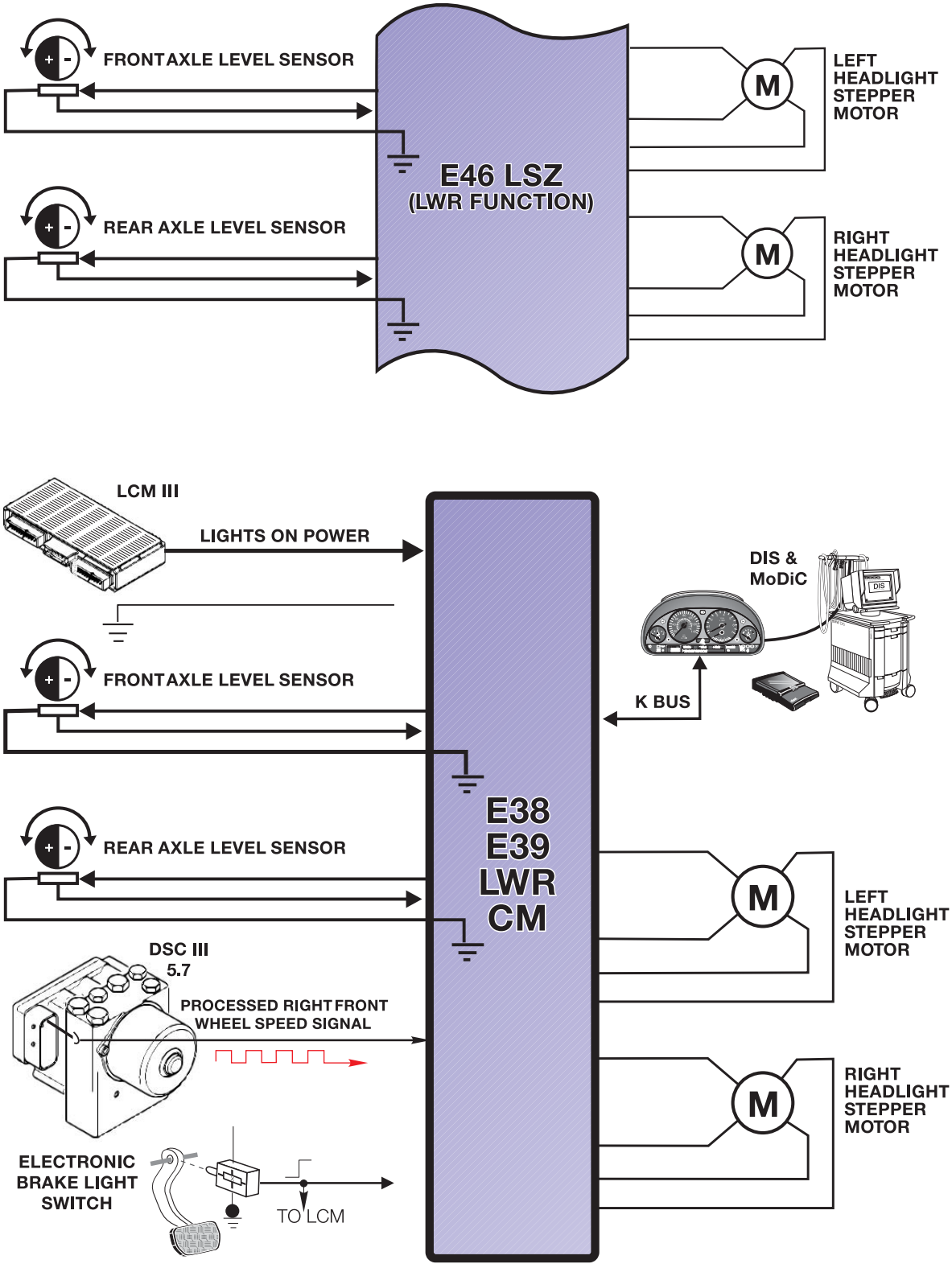
Headlight Alignment

The procedure for aligning Xenon Headlights with LWR is the same as conventional halogen bulb systems with one additional step. Wait at least 30 seconds for the LWR to cycle and adjust to it's calculated position.

LWR Diagnosis

The LWR control module of the E38/E39 is diagnosable using the DISplus/GT-1.
The headlights must be switched on in order to start diagnosis.

LWR IPO


FRONT AXLE LEVEL SENSOR
REAR AXLE LEVEL SENSOR
E46 LSZ
(LWR FUNCTION)
M
LEFT HEADLIGHT STEPPER MOTOR
M
RIGHT HEADLIGHT STEPPER MOTOR
LCM III
LIGHTS ON POWER
FRONT AXLE LEVEL SENSOR
REAR AXLE LEVEL SENSOR
DSC III 5.7
PROCESSED RIGHT FRONT WHEEL SPEED SIGNAL
ELECTRONIC BRAKE LIGHT SWITCH
TO LCM
E38
E39
LWR
CM
DIS & MoDiC
K BUS
M
LEFT HEADLIGHT STEPPER MOTOR
M
RIGHT HEADLIGHT STEPPER MOTOR

Classroom Exercise - Review Questions

1. What components does the LCM replace as compared to previous models?

2. What is the difference between the LM and LCM?

3. Explain “Cold Monitoring” of the lamp circuits:

4. How does the LCM detect brake light switch failure?

5. Why are Xenon bulbs NOT cold monitored?

Classroom Exercise - Review Questions

6. What is the purpose of LWR?

7. What is new about the LCM III?

8. What functions does the LCM perform when a crash input is received?

9. What are the differences between a Halogen Lamp and a Xenon Lamp?